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The nomenclatural history of *Umbilicaria spodochroa* and nomenclatural corrections in *Umbilicariaceae*

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Abstract—The name *Umbilicaria spodochroa* is currently applied to a species with an oceanic distribution in Europe and East Asia. The upper surface of its thallus is grey to dark brown, apothecia are omphalodiscs with prominent central umbilicus-like buttons. Its designated type and other original material are referred to *U. hirsuta*. Conservation is required to retain this name in current use. The nomenclatural history of *U. spodochroa* is presented to serve as the background for its conservation. The subgeneric nomenclature of *Umbilicaria* is revised and one new name (*U.* subg. *Papillophora*) is proposed to replace the illegitimate *U.* subg. *Gyrophora*. The status of many new names published by G.F. Hoffmann in his "Deutschlands Flora" (1796) is discussed and their nomenclatural validity is supported.

Key words—conservation, Ehrhart, historical collections, Hoffmann, typification

Introduction

Species of *Umbilicariaceae* Chevall. are predominantly saxicolous lichens mostly found in regions of higher latitudes or altitudes worldwide. Multilocus phylogenies resulted in a new generic concept of the family, which currently includes three genera comprising together about one hundred species with mostly umbilicate growth habit (Bendiksby & Timdal 2013, Davydov & al. 2017).

Morphological details of the upper and lower thallus surfaces as well as traits of the rhizinomorphs were mostly taken into consideration by earlier lichenologists to distinguish species of *Umbilicaria* Hoffm. However, these characters have not always been easily recognizable. For this reason, the circumscriptions of some of the early described species have been controversially discussed. One species with a rather complicated taxonomic and nomenclatural history is *Umbilicaria spodochroa* which, in the 18th and 19th centuries, was often confused with another early described species, *U. hirsuta* (Sw.) Ach.

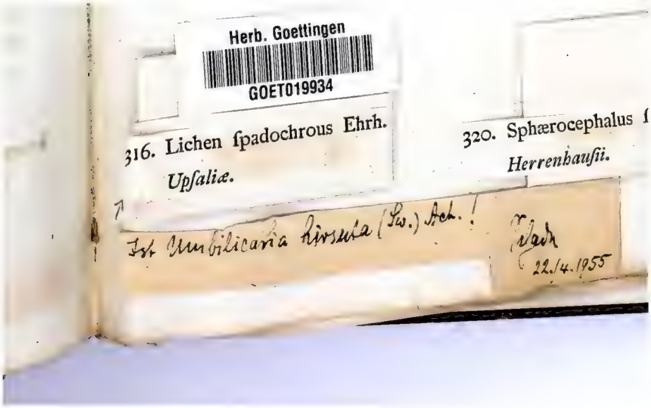
Umbilicaria spodochroa, with an oceanic distribution in Europe and East Asia (Wei & Jiang 1993), is characterized by a large thallus with a grey to dark brown upper surface and pale brown to black papillate lower surface with abundant rhizinomorphs and characteristic omphalodisc-type apothecia with prominent central umbilicus-like buttons. By such characterization, this species is easily recognizable, and specimens thereof were frequently distributed in exsiccatal series (see the list in Llano 1950).

Umbilicaria hirsuta, a Holarctic species, is characterized by producing parasoredia on the marginal part of the upper thallus surface, unlike the closely related *U. grisea* Hoffm. in which the parasoredia clump and become farinose with variously sized granules (Codogno & al. 1989). The lower surface of *U. hirsuta* is beige to almost black with sparse to abundant rhizinomorphs. Apothecia, which are rarely produced, belong to the gyrodisc type.

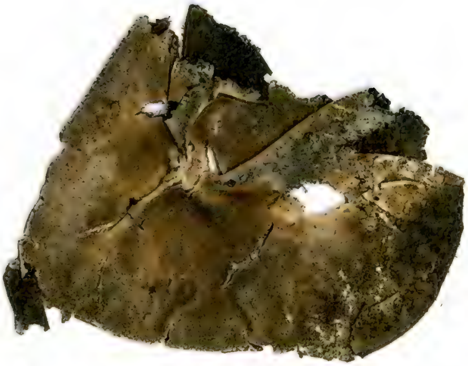
As currently defined (Frey 1933, Llano 1950, Codogno & al. 1989, Wei & Jiang 1993), *Umbilicaria hirsuta* and *U. grisea* can be unambiguously distinguished by their diagnostic characters as stated above. Both species names are currently accepted (Poelt & Vězda 1981, Hitch & Purvis 2009, Stenroos & al. 2016), and the species were assigned to the recently resurrected "*Umbilicaria* subg. *Gyrophora* (Ach.) Frey" (Davydov & al. 2017), which corresponds to a rather large clade of 13 phylogenetically analysed species. The core of this clade is constituted by the *Umbilicaria vellea* group, which includes *U. spodochroa* and *U. hirsuta*.

In spite of the current advances in the taxonomy of *Umbilicariaceae*, the nomenclature of several species is still to be clarified. In the present contribution we aim at unravelling the old confusion concerning the species name *Umbilicaria spodochroa*.

FIGURE 1. Type collection of *Umbilicaria spodochroa*, voucher from Göttingen (GOET 019934). A. printed label of Ehrhart's exsiccata; B. upper surface of thallus; C. lower surface of thallus. Photo: Marc Appelhans.


Herb. Goettingen
GOET019934
316. Lichen ſpadochrous Ehrh.
Upſaliæ.
320. Sphærocephalus
Herrenhauſii.
Ist Umbilicaria hirsuta (Sw.) Ach.!
22./4.1955

A



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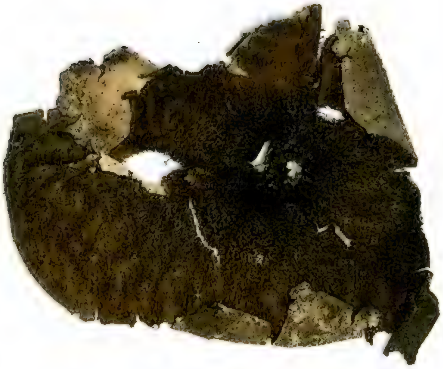

C

Materials & methods

The protologue of *Umbilicaria spodochroa* and the relevant historical literature was examined to uncover the history and the original material of the name. Herbarium collections and high resolution digital photographs of *Umbilicaria* from GOET, H, LE, LINN, and MW were studied de visu, via online portals (https://plants.jstor.org), or provided by curators. Taxonomic literature was screened for relevant treatments.

Historical background

A species of *Umbilicaria* with the specific epithet "spodochrous" was first introduced by Ehrhart (1793), who distributed a specimen named "*Lichen spadochrous* Ehrh." among his exsiccatae (Fig. 1). The specimen was accompanied with a printed label, but no description or diagnosis of the species was provided.

The species epithet is controversial because in its original spelling it is meaningless and has long been considered linguistically erroneous (e.g., Schade 1955). Nylander (1861: 115; 1869: 11) stated that the epithet "spadochrous" seems to be a misspelling because it is apparently derived from the Greek word σποδός (cinder), meaning "ashes". Since the species epithet was incorrect, either as a typographic or orthographic error, under ICN (Shenzhen Code) Art. 60.1 its spelling may be corrected to "spodochrous," which is currently in common use.

Acharius (1794) referred Ehrhart's specimen of *Lichen* "*spadochrous*" to *L. polyrrhizos* L. This was done under a broad species concept and had no practical influence on the further taxonomy or nomenclature.

Valid publication and protologue

Hoffmann (1796) revised species of cryptogams (ferns, mosses, and lichens) known from Germany. Since the available knowledge was very uneven and several taxa were not sufficiently understood at that time, he treated the taxa differently as he explained in the Preface:

"Varietäten, Halbarten (Subspecies), auch Arten, welche ich als solche aufzuführen noch unentschlossen war, findet man entweder in Klammern ... den Anmerkungen, oder ohne Bezifferung der nächstverwandten Art beigestellt" [= Varieties, subspecies, also species that I was still undecided to list as such, are to be found either in parentheses ( ) placed with the annotations, or, without numeration, with the most closely related species] (Hoffmann 1796: [Vorbericht: 4]).

In the Index, according to our interpretation of this work, Hoffmann (1796) implicitly listed accepted names and their basionyms in italics and synonyms in the regular font. In the taxonomic part of his work, he listed many species without numbers, yet with binomial names in the accepted genus. Several of such species were new to science. In annotations placed in brackets, Hoffmann mentioned quite a number of species names published by previous authors, with their original generic assignments. He also mentioned several varieties in these annotations, usually unnamed or under old polynomials, sometimes with previously published species names; according to the Index, such species names were listed as synonyms. Hoffmann's use of subspecies was very sparse, and we are not aware of any name that he may have applied at this rank.

Isoviita (1966) considered new names in Hoffmann's treatments of "undecided" taxa invalidly published because of the presumed absence of explicit acceptance by the author [ICN (Shenzhen Code) Art. 36.1]. Contrary to his opinion, we consider the internal evidence in Hoffmann (1796) (typesetting of the Index and explanations in the Preface) to be sufficient to dispel doubts about Hoffmann's acceptance of such taxa.

Hoffmann (1796) was the first to provide a description for Ehrhart's lichen under the name *Umbilicaria* "*spadochroa*"; although this species name was left unnumbered in the synopsis, it was listed as accepted in the Index and therefore was validly published in spite of any doubts that Hoffmann may have had at that time.

The species description provided by Hoffmann inadequately distinguishes between the *Umbilicaria* species in their current circumscription. Hoffmann distinguished *U. spodochroa* from its presumed closest relative *U. hirsuta* mostly by the colour of the upper thallus surface (bluish grey vs. grey) and the lower thallus surface (light brown vs. brownish grey), and also by rhizinomorph density (scarce vs. abundant). These characters are variable in both species in that the colour of the lower thallus surface varies from beige to black-brown and the rhizinomorphs are scarce to abundant. According to the current species concept, Hoffmann's description fits both taxa, *U. spodochroa* and *U. hirsuta*, so that it can be applicable either to a species different from *U. hirsuta* or it may indicate a phenotypic variation within the same species.

Further treatments

A later author who treated this lichen species was Acharius (1799), who validly published the combination *Lichen spodochrous* (as "spadochrous"), which he explicitly accepted and accompanied by a species description.

Acharius broadened the limits of this taxon and, disregarding priority, included one previously described species, *Umbilicaria cirrosa* Hoffm.; this name has not yet been typified but the figures accompanying the description by Hoffmann (1789) suggest that it may be a synonym of *U. vellea*.

Acharius (1799, 1803) specified the character of the lower surface of the thallus as dark hirsute ("subtus ater hirsutus"). Later, Acharius (1810: 673) emphasized that his *Gyrophora vellea* (L.) Ach., *G. spodochroa*, and *G. crustulosa* Ach. can be optimally distinguished by their apothecial morphologies. In this work, Acharius was the first to mention one of the most important diagnostic characters of *Umbilicaria spodochroa*, i.e., the prominent central button on the apothecia. Finally Acharius (1814) lowered the rank of the taxon to the varietal level but maintained its diagnostic characters.

It is rather obvious that the works of Acharius were essential in establishing the current concept of *U. spodochroa*. Nevertheless, despite the characters indicated in his descriptions, the specimens labelled by Acharius as "*Gyrophora vellea* β *G. spadochroa*" belong to *U. vellea* (H-ACH 581) or *U. vellea* and *U. cinereorufescens* (Schaer.) Frey (H-ACH 580). The specimens referable to *U. spodochroa* were identified by Acharius as "*Gyrophora vellea*" (H-ACH 576), in accordance with the illustration of the latter species in Acharius (1794: Tab. III, fig. 3).

Stenhammar (1825) described the same type of apothecia, with thick margin and a central verruca, for *Umbilicaria vellea* var. *spodochroa,* although the respective herbarium specimen was referred to *U. vellea* (Merrill 1906). The other important diagnostic characters of the species were unknown at that time.

Nylander (1861) established an additional character that can diagnose *Umbilicaria spodochroa:* ascospores that are simple and colourless to submuriform and brown. However, he treated *U. spodochroa* broadly and included other *Umbilicaria* taxa with submuriform ascospores: *U. cinereorufescens, U. cirrosa, U. crustulosa,* and *U. depressa* (Ach.) Duby (Nylander 1869).

This broad concept of *Umbilicaria spodochroa* prevailed until Frey (1933) recognized the four aforementioned species as separate and provided an artificial key and detailed descriptions, which are still accepted. Frey's treatment became the basis for all subsequent interpretations of *U. spodochroa* and established the current application of its name.

Type designation

Hoffmann (1796) cited two collections in the protologue, which are therefore syntypes. The first collection is *Lichen* "*spadochrous*" of Ehrhart (1793), which was erroneously cited under no. 317 instead of no. 316. The distribution of Ehrhart's exsiccatae was so limited (Gubanov & Balandina 2000) that this incorrect citation was reproduced in the great majority of subsequent taxonomic publications.

We were able to locate three specimens of Ehrhart's "*Lichen spadochrous*" at GOET, LINN-HS, and MW. In addition we checked B, BM, G, HAL, LE, M, and UPS (the herbaria in which some Ehrhart's collections are known to be located), but without success.

The specimen at GOET (barcode 019934) was studied by Arnold (1880) and Schade (1955), who referred it to *Umbilicaria hirsuta*. We agree with this identification because of its prominent marginal farinose-granular parasoredia.

The specimen at LINN-HS (1703.19.3) belongs to the Herbarium of Sir James Edward Smith, to which it went through the collection of Edmund Davall in 1802 (Beer 1947). According to the annotations, Smith referred it to "*Lichen polyrrhizos,*" although its correct identity is *Umbilicaria hirsuta*.

The specimen at MW belongs to the personal collection of F. Ehrhart, which was owned by Hoffmann who left its part, including sets of the exsiccatae, to the Moscow Branch of the Military Medical-Surgical Academy, from which the collections were transferred to the Moscow University after the Academy was closed in 1842 (Sokoloff & al. 2002). Some specimens of Ehrhart's cryptogams were purchased by the Botanical Museum of the St. Petersburg Academy of Sciences (now the Komarov Botanical Institute) (Karavaev & Barsukova 1968) but the specimen of *Lichen* "*spadochrous*" was left in Moscow (Gubanov & Balandina 2000). This specimen was certainly examined by Hoffmann and apparently was the main basis for the original description and his concept of *Umbilicaria spodochroa*. The traits of his specimen do match the original description well, but it evidently also belongs to *U. hirsuta*.

The second collection mentioned by Hoffmann (1796) is a specimen of "*Lichen polyrrhizos,*" which was communicated by Smith. We cannot recognise this specimen among the lichen collections of Hoffmann, which were purchased from him by Moscow University (Hoffmann 1825). However, a suitable specimen in Smith's herbarium (LINN-HS 1273.212), identified as "*Lichen polyrrhizos*" and originating from Ehrhart's collection, matches the protologue of *Umbilicaria spodochroa*. This specimen, which was received by Smith most likely in 1793 (as evident from annotations on other similar specimens in this collection, e.g. LINN-HS 39.34) and may have been shared with Hoffmann prior to 1796, could be part of the gathering mentioned by Hoffmann in the protologue. This specimen also belongs to *U. hirsuta*.

The original description of *Umbilicaria spodochroa* and the relevant herbarium material convincingly demonstrate that this name was applied by Hoffmann to a variant of *U. hirsuta*, not to the species known as *U. spodochroa* in the current use. Arnold (1880) studied Ehrhart's lichen collections and stated that Ehrhart's specimen of *Lichen* "*spadochrous*" was mixed and the typical *U. spodochroa* was also present under no. 316; however, we have found no evidence for this statement. Moreover, *U. hirsuta* is common in the vicinity of Uppsala (Shah & Coulson 2018), the type locality of *U. spodochroa*, whereas *U. spodochroa* in its current concept is absent from Uppsala proper, although it occurs fairly close to the town, mostly along the coast and to some extent along the shores of Lake Mälaren (S. Ekman, pers. comm.).

Llano (1950: 101) rather mechanically cited "Ehrhart … Crypt. Exs. 317" as the type of *Umbilicaria spodochroa*, thus fulfilling conditions for effective type designation [ICN (Shenzhen Code) Art. 7.11, 9.17]. This typification is formally correct but has an undesirable effect that a familiar species name would change its application because the type collection belongs to *U. hirsuta* although the species name has been widely and persistently used in the sense of *U. spodochroa* since Frey (1933). Llano's type designation is referable to a gathering rather than a specimen, since he failed to specify the herbarium in which the type is housed, but we refrain from the second-step typification of the name as unnecessary in view of a conservation proposal currently under review (Hestmark, submitted).

Umbilicaria spodochroa Hoffm., Deutschl. Fl. 2: 113. 1796, [as "*spadochroa*"]

≡ *Lichen spodochrous* (Hoffm.) Ach., Lichenogr. Suec. Prodr.: 149. 1799 ["1798"; as "*spadochrous*"]
≡ *Gyrophora spodochroa* (Hoffm.) Ach., Methodus: 108. 1803 [as "*spadochroa*"]
≡ *Gyrophora vellea* var. *spodochroa* (Hoffm.) Ach., Syn. Meth. Lich.: 68. 1814 [as "*spadochroa*"]
≡ *Umbilicaria vellea* var. *spodochroa* (Hoffm.) Stenh., Sched. Crit. Lichen. Suec. 5–6: 4. 1825 [as "*spadochroa*"]
≡ *Omphalodiscus spodochrous* (Hoffm.) Schol., Nyt Mag. Naturvid. 75: 26. 1934

LECTOTYPE (designated by Llano 1950: 101)—Sweden. Uppsala, F. Ehrhart in Plantae Cryptogamae Linn. no. 316 (GOET [image!], LINN-HS [image!], MW [image!]).

Subgeneric nomenclature

Gyrophora Ach. was published as an explicit substitute [replacement name, ICN (Shenzhen Code) Art. 6.11] for the illegitimate *Umbilicaria* Hoffm. 1789 (non Fabr. 1759), even though the illegitimacy of Hoffmann's genus was not realized at that time (e.g., Leighton 1856). Acharius (1803: 100) cited Hoffmann's name in synonymy and stated that he changed the latter because he considered it "not optimal", thus making both names homotypic [ICN (Shenzhen Code) Art. 7.4]. Since the generic name *Umbilicaria* Hoffm. was illegitimate prior to its conservation in 1996 [ICN (Shenzhen Code) Art. 14.15], the autonym "*Umbilicaria* subg. *Umbilicaria*" cannot be established [ICN (Shenzhen Code) Art. 22.5]; because of the illegitimacy of the generic name, ICN (Shenzhen Code) Art. 22.2 does not apply and the combination *Umbilicaria* subg. *Gyrophora* (Ach.) Frey was validly published for a subdivision of the genus that includes the type of the generic name. When Davydov & al. (2017) accepted *U.* subg. *Gyrophora* but excluded from its circumscription the type of *Umbilicaria* (which is also the type of *U.* subg. *Gyrophora* (Ach.) Frey), also providing a description of this subgenus and a type designation, they created an illegitimate later homonym [ICN (Shenzhen Code) Art. 48.1] which, however, was not validly published under ICN (Shenzhen Code) Art. F.5.1. This subgenus is formally named here with the same type and a reference to the validating description in Davydov & al. (2017).

Two other subgeneric names accepted by Davydov & al. (2017) are revised with their corrected nomenclature as follows.

Umbilicaria* subg. *Agyrophora Nyl. [Flora 61: 247. 1878, nom. nud.] ex Cromb., Monogr. Lich. Britain 1: 323. 1894

Type (designated by Llano 1950: 49)—*Umbilicaria atropruinosa* Schaer.
[= *Umbilicaria leiocarpa* DC.]

Umbilicaria* subg. *Lasallia (Mérat) Frey, Hedwigia 71: 106. 1931

≡ *Lasallia* Mérat, Nouv. Fl. Env. Paris, ed. 2, 1: 202. 1821

Type—*Umbilicaria pustulata* (L.) Hoffm.

Umbilicaria* subg. *Papillophora Davydov, Ahti & Sennikov, subg. nov.

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≡ "*Umbilicaria* subg. *Gyrophora*" sensu Davydov & al., Taxon 66: 1297. 2017.

Type—*Umbilicaria vellea* (L.) Ach.

Description—see Taxon 66: 1297. 2017, under *Umbilicaria* subg. *Gyrophora* "(Ach.) Frey".

Etymology—The name refers to the papillose lower surface and rhizinomorphs, the characteristic trait for the majority of species in the subgenus.

Acknowledgments

Norbert Kilian (Berlin) kindly commented on the complicated taxonomy and nomenclature of Hoffmann (1796) and provided his English translation of the quoted passage. We are grateful to Marc Appelhans (Göttingen) for scanned images and a photocopy of the printed matter of Ehrhart's exsiccatae from GOET. Mikhail Kozhin (Moscow) supplied a photograph from Ehrhart's collection at MW. The following curators kindly reported the absence of Ehrhart's specimens: Stefan Ekman (UPS), Uwe Braun (HAL), Andreas Beck (M), Robert Lücking (B), Philippe Clerc (G), Len Ellis (BM). Stefan Ekman is also thanked for information on the occurrence of the species of *Umbilicaria* around Uppsala. A photograph of *Umbilicaria spodochroa* from GOET is reproduced with kind permission from the Georg-August-Universität Göttingen. We thank Christian Printzen (Senckenberg Research Institute Frankfurt, Germany) and Gerhard Rambold (University of Bayreuth, Germany) for expert presubmission review.

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Ochroconis terricola sp. nov. from China

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Abstract—A new species, *Ochroconis terricola*, was isolated from soil in Guizhou Province, China. Morphology and phylogenetic analyses of the combined sequence data of nuclear ribosomal DNA genes (ITS, LSU, SSU) revealed the strain as different from other *Ochroconis* species.

Key words—*Dothideomycetes,* hyphomycetes, *Sympoventuriaceae,* taxonomy, *Venturiales*

Introduction

Ochroconis, typified by *O. constricta* (E.V. Abbott) de Hoog & Arx, was morphologically separated from *Scolecobasidium* E.V. Abbott (Abbott 1927) by de Hoog & von Arx (1974), for species with unbranched, ellipsoidal to cylindrical conidia, while *Scolecobasidium* was retained for species having T- or Y-shaped conidia. However, the taxonomic status of *Scolecobasidium* was questioned due to ambiguity of its type species, *S. terreum* E.V. Abbott, and species with lobed conidia similar to *S. terreum* in *Scolecobasidium* have been combined in *Ochroconis* on phylogenetic grounds (Samerpitak & al. 2014). Historically, *Ochroconis* was characterized by sympodial conidiogenesis and septate, mostly rough-walled conidia that are liberated rhexolytically (Samerpitak & al. 2015, Ellis 1971). A recent multigene (nSSU, nLSU, mtSSU, RPB2) phylogenetic analysis places *Ochroconis* in *Sympoventuriaceae* (*Venturiales*, *Dothideomycetes*) (Machouart & al. 2014). By combining molecular phylogeny, morphology, and ecology, Samerpitak & al. (2014) revised the taxonomy of the *Ochroconis* lineage, introducing

Verruconis Samerp. & al. as a new genus for a group of thermophilic species around *O. gallopava* (W.B. Cooke) de Hoog [≡ *Verruconis gallopava* (W.B. Cooke) Samerp. & de Hoog]. (*Ochroconis* species are mesophilic.) ITS and LSU nuclear ribosomal sequences as well as the conserved SSU gene are all suitable for identifying species in *Ochroconis* and *Verruconis*, but the ITS and LSU regions are recommended as the best DNA barcoding candidates, due to the high variability found even in conserved markers (Samerpitak & al. 2014, 2015). Presently, 31 species are accepted in *Ochroconis* (http://www.mycobank.org).

During our 2018 investigation of dematiaceous hyphomycete diversity, we isolated one *Ochroconis*-like strain from soil in Guizhou Province, China. Now we propose a novel species, *Ochroconis terricola,* based on morphological characters and phylogenetic analyses of ITS, LSU, and SSU nuclear ribosomal sequences.

Materials & methods

Fungal isolates and morphological studies

Soil samples were collected from Guizhou Province, China, in 2018 and transported to the laboratory in sterilized, zip lock polyethylene bags. All isolates are conserved in the Herbarium of Department of Plant Pathology, Guizhou University (HGUP). The taxon is described from cultures grown for 2 weeks at 25°C on potato dextrose agar (PDA). Conidia and conidiophores were placed in a drop of 60% lactic acid, examined, and photographed at 100× magnification using a Nikon 90i microscope.

DNA extraction, amplification, sequencing

Genomic DNA was extracted from colonies grown on PDA using the Fungal gDNA Kit GD2416 following the manufacturer's instructions. ITS, LSU and SSU genes were amplified via PCR using primers ITS4/ITS5 (White & al. 1990), LROR/LR5 (Rehner & Samuels 1994, Vilgalys & Hester 1990), and NS1/NS4 (White & al. 1990), respectively. The PCR products were purified and sequenced by Sangon Biotech. The new sequences were deposited in GenBank, and other sequences were obtained from GenBank (Table 1).

Phylogenetic analyses

Sequences were aligned using ClustalX 1.81 (Thompson & al. 1997) and edited manually using BioEdit (Hall 1999). The alignments were concatenated as a Fasta document using MEGA 6.0 (Tamura & al. 2011). Phylogenetic analyses of combined ITS, LSU, and SSU rDNA sequences were computed using maximum likelihood (ML) analysis and Bayesian Inference (BI). The ML tree was generated using RAxML-HPC2 on XSEDE v.8.2.8 (Stamatakis 2014) via the CIPRES Science Gateway platform (Miller & al. 2010) with 1000 bootstrap replicates. Bayesian analysis was performed via MrBayes v3.0b4 (Huelsenbeck & Ronquist 2001) using Markov Chain Monte

Table 1. Sequences used in phylogenetic analyses.

Species	Strain	GenBank accession no.		
		ITS	SSU	LSU
Mycosisymbrium cirrhosum	GUFCC 18012	KR259883	KR259885	KR259884
Ochroconis bacilliformis	CBS 100442	KP798632	KP798638	KP798635
O. constricta	CBS 202.27(T)	MH854929	KF156072	KF282652
	CBS 211.53	HQ667519	KF282671	KF282653
	NH 1234	—	—	LC187202
	FMR 3906	LM644509	—	LM644552
	NBRC 9375	DQ307327	AB564608	AB564619
O. cordanae	CBS 475.80(T)	KF156022	KF282672	KF282654
O. gamsii	CBS 239.78(T)	KF156019	KF156088	KF156150
O. icarus	CBS 536.69(T)	HQ667524	KF156084	KF156132
O. macrozamiae	CBS 101179	KF156020	KF156091	KF156151
	CBS 102491	KF156021	KF156092	KF156152
O. minima	CBS 423.64	—	KF282680	KF282666
	CBS 119792	KF156027	KF156086	KF156133
	CBS 510.71(T)	HQ667522	KF156087	KF156134
O. phaeophora	CBS 206.96	KP798631	KF282675	KF282660
O. ramosa	UTHSC 121082(T)	LM644524	LM644551	LM644567
O. robusta	CBS 112.97(T)	KP798633	KP798639	KP798636
O. sexualis	PPRI 12991(T)	KF156018	KF156089	KF156118
O. terricola	**HGUP1808(T)**	**MK377301**	**MK377071**	**MK377073**
Pleospora herbarum	CBS 191.86	KC584239	GU238232	GU238160
Scolecobasidium cateniphorum	CBS 769.83	KF156013	KF156044	KF156153
S. excentricum	CBS 469.95(T)	HQ667543	KF156096	KF156105
S. fusarioideum	CBS 210.95	—	KF156043	KF156154
S. fusiforme	CBS 586.82	KF156012	KF156101	KF156155
Scolecobasidium sp.	NH503	—	AB564606	AB564617
S. terreum	PO43	—	EU107356	EU107306
S. tricladiatum	PO51	—	EU107354	EU107286
S. tropicum	CBS 380.87	—	KF156042	KF156102
Venturia asperata	ATCC 34052	—	EF114736	EF114711
V. inaequalis	CBS 594.70	KF156040	GU296205	GU301879
V. populina	CBS 256.38	MH855959	GU296206	GU323212
V. pyrina	ATCC 38995	—	EF114739	EF114714
Veronaeopsis simplex	CBS 588.66(T)	KF156041	KF156095	KF156103
Verruconis calidifluminalis	CBS 125818(T)	MH875239	KF156046	KF156108
V. gallopava	CBS 437.64(T)	HQ667553	KF282674	KF282656
V. verruculosa	CBS 119775	KF156014	KF156055	KF156106

New sequence is set in **bold** font. Type strains are marked by T.

Carlo method. *Pleospora herbarum* (CBS 191.86) was used as an outgroup. The phylogenetic tree was viewed in Treeview v. 1.6.6 and the layout was completed in Adobe Illustrator CS5.

Taxonomy

Ochroconis terricola **Xin Zhang & Y.L. Jiang, sp. nov.** FIG. 1

MB 831137

Differs from *Ochroconis macrozamiae* by its dark brown conidiophores and subhyaline to pale brown conidia, from *O. gamsii* by its flexuous conidiophores and bigger conidia, and from *O. sexualis* by its 1-septate and much smaller conidia.

TYPE: China, Guizhou Province, Leishan County, from forest soil, March 2018, X. Zhang (**Holotype**, HGUP1808; ex-type culture, HGUP1808; GenBank MK377301, MK377071, MK377073).

ETYMOLOGY: referring to living on the soil.

COLONIES on PDA effuse, flat, velvety, olivaceous, reverse dark brown, growing slowly, attaining 9 cm diam. at 25° after 4 weeks. MYCELIUM immersed and superficial, hyphae hyaline to pale brown, smooth. CONIDIOPHORES unbranched, 1–6 septa, flexuous, thick-walled, dark brown, 2–4 µm diam., with sympodially proliferating conidiogenous cells bearing one or more denticles in the apical region. CONIDIOGENOUS CELLS terminal, integrated, 1–3 µm long, polyblastic, cylindrical, subhyaline to medium brown. CONIDIA rhexolytic secession from conidiophores, solitary, subhyaline to pale brown, coarsely verrucose, 1-septate, sometimes slightly constricted at the septum, ellipsoidal to cylindrical or fusiform, apex mostly rounded, base narrowly truncated with minute marginal frills, 7–12 × 2–4 µm.

Phylogenetic analysis

The final alignment contained three genes for 36 isolates and 2568 (765 ITS + 827 LSU + 976 SSU) characters with *Pleospora herbarum* (CBS 191.86) as outgroup. The ML phylogenetic tree is shown (FIG. 2). Empirical base frequencies with 1,000 bootstrap inferences are 0.249211 (pi A), 0.221282 (pi C), 0.295026 (pi G), and 0.234480 (pi T). Bayesian analysis generated a similar phylogenetic tree (one million generations; average standard deviation of split frequencies = 0.009724). The *Ochroconis terricola* (HGUP 1808) sequences cluster together in a clade with *O. macrozamiae* Crous & R.G. Shivas, *O. gamsii* de Hoog, and *O. sexualis* Samerp. & al. (FIG. 2) and form a single branch sister to the other three species with high bootstrap support (ML/BI = 84/1).

Discussion

In this study, one *Ochroconis* strain (HGUP1808) isolated from soil was identified based on morphological characters and molecular data.

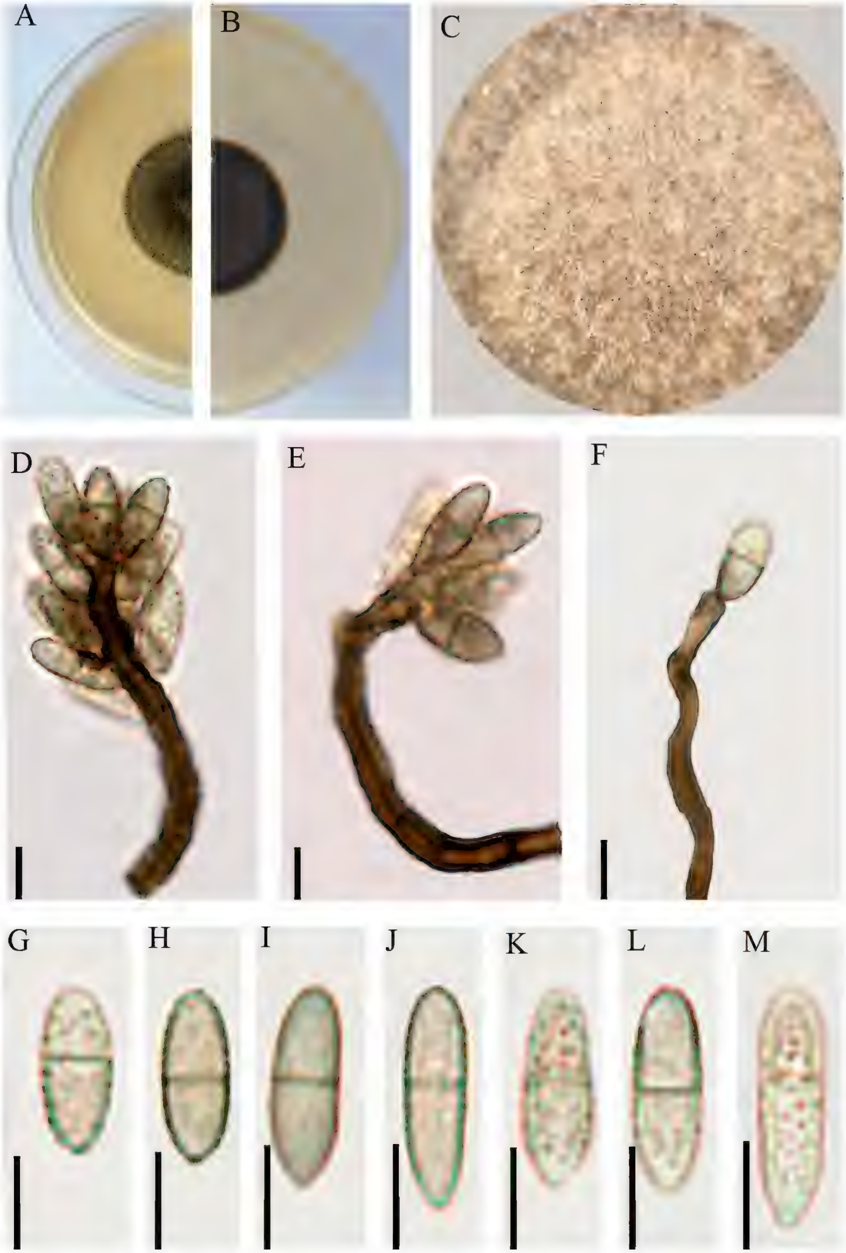

Fig. 1. *Ochroconis terricola* (holotype, HGUP1808). A, B: Colony on PDA at 14 days; C: Mycelia on the colony; D–F: Conidiophores and conidia; G–M: Conidia. Scale bars = 5 µm.

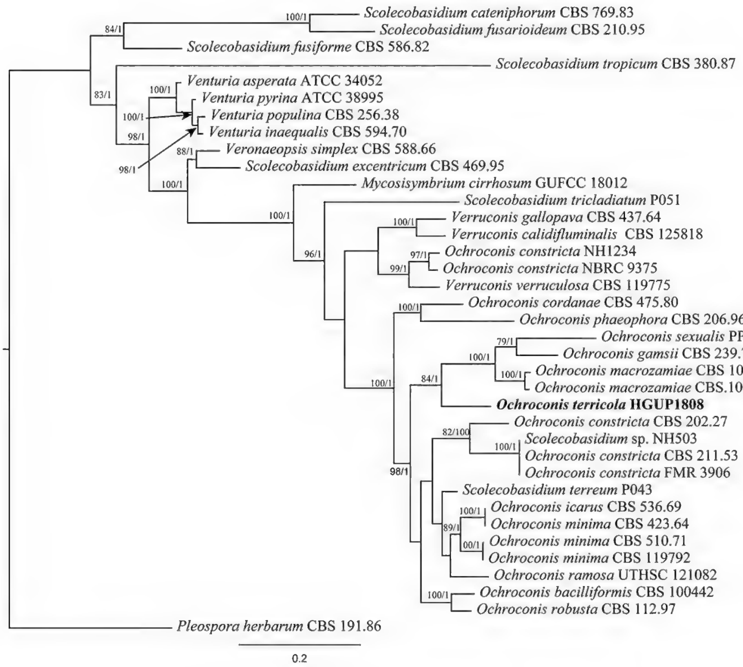
Scolecobasidium cateniphorum CBS 769.83
Scolecobasidium fusarioideum CBS 210.95
Scolecobasidium fusiforme CBS 586.82
Scolecobasidium tropicum CBS 380.87
Venturia asperata ATCC 34052
Venturia pyrina ATCC 38995
Venturia populina CBS 256.38
Venturia inaequalis CBS 594.70
Veronaeopsis simplex CBS 588.66
Scolecobasidium excentricum CBS 469.95
Mycosisymbrium cirrhosum GUFCC 18012
Scolecobasidium tricladiatum P051
Verruconis gallopava CBS 437.64
Verruconis calidifluminalis CBS 125818
Ochroconis constricta NH1234
Ochroconis constricta NBRC 9375
Verruconis verruculosa CBS 119775
Ochroconis cordanae CBS 475.80
Ochroconis phaeophora CBS 206.96
Ochroconis sexualis PPRI 12991
Ochroconis gamsii CBS 239.78
Ochroconis macrozamiae CBS 101179
Ochroconis macrozamiae CBS.102491
Ochroconis terricola HGUP1808
Ochroconis constricta CBS 202.27
Scolecobasidium sp. NH503
Ochroconis constricta CBS 211.53
Ochroconis constricta FMR 3906
Scolecobasidium terreum P043
Ochroconis icarus CBS 536.69
Ochroconis minima CBS 423.64
Ochroconis minima CBS 510.71
Ochroconis minima CBS 119792
Ochroconis ramosa UTHSC 121082
Ochroconis bacilliformis CBS 100442
Ochroconis robusta CBS 112.97
Pleospora herbarum CBS 191.86
100/1
84/1
83/1
100/1
100/1
98/1
98/1
88/1
100/1
100/1
96/1
100/1
97/1
99/1
100/1
79/1
100/1
100/1
84/1
100/1
82/100
100/1
98/1
100/1
89/1
00/1
100/1
0.2

Fig. 2. Maximum Likelihood (ML) tree based on combined LSU, ITS, and SSU data of *Ochroconis* species and other related genera species, with *Pleospora herbarum* (CBS 191.86) as outgroup. Branch support is shown as: Maximum Likelihood bootstrap support values >75% / Bayesian posterior probabilities >0.95. The new species is in bold.

SSU, ITS, and LSU multi-gene analyses support phylogenetic separation of *O. terricola* from known *Ochroconis* species within a single clade in the ML tree. Although *Ochroconis terricola* is phylogenetically close to *O. macrozamiae, O. gamsii*, and *O. sexualis* in the phylogram (Fig. 2), there are obvious morphological differences separating *O. terricola* and the three species. *Ochroconis macrozamiae* is distinguished by its red-brown conidiophores and conidia that constrict at the middle septum (Crous & al. 2014); *O. gamsii* differs by its erect conidiophores and curved or unilaterally flattened, smaller conidia (6–9 × 2.4–2.8 µm; de Hoog 1985); and *O. sexualis* differs by its 1–3-septate, larger conidia (15–22 × 3.5–5.0 µm; Samerpitak & al. 2014). The combined morphological and phylogenetic analysis supports *O. terricola* as a new taxon.

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